

System Noise Temperature Calibrations of the Research and Development Systems at DSS 14

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This article reports recent precision system noise temperature measurements made with the X- and S-band systems as they will be used for the Mariner Venus/Mercury 1973 (MVM'73) mission. Elevation and azimuth profiles for both the S-band and X-band systems are also presented. A summary of the zenith system noise temperature measurements for calendar year 1973 for the diplexed S-band systems at DSS 14 is described and plotted.

In a previous article (Ref. 1), system temperature measurements were made at DSS 14 of the S-band Megawatt Transmit (SMT) cone S-band system and the multifrequency X- and K-band (MXK) cone X-band system. These measurements were elevation profiles with the reflex feed system both extended and retracted. Since these measurements were made, certain improvements (Ref. 2) have been made to the maser in the SMT cone, the effect of which has been to reduce the SMT system operating noise temperature. Other improvements since previous reports

(Ref. 3) have included the taping of the 64-m antenna surface. This article reports recent precision system temperature measurements made with the X- and the improved S-band systems, as they will be used for the MVM'73 mission. The present measurements were made with the Noise-Adding Radiometer (Ref. 4) and the ambient load terminations. Verification tests of the ambient load were made with a microwave absorber over the horn, and voltage standing wave ratios of the ambient load and horn were checked.

Figure 1 shows elevation profiles for the S- and X-band systems. The S-band data were obtained with maser serial number 80S2 in the SMT cone and the X-band data with maser serial 150X2 in the MXK cone. The dichroic feed system was extended, the atmosphere was clear, and the antenna azimuth was fixed at 180 deg. The masers were tuned to 2295 and 8415 MHz, respectively, and the follow-up receiver contribution was measured as less than 0.1 K in each case.

Table 1 is a summary of the system operating noise temperature performance of the SMT and MXK cones. The dichroic feed system does not degrade the S-band system temperature at high elevation angles (above 30 deg). The S- and X-band system temperature at zenith was measured as 12.4 and 21.1 K, respectively, with the dichroic feed system extended.

Figure 2 shows S-band azimuth profiles for three different elevation angles. The azimuth angles were chosen to correspond approximately to the angles at which the MVM73 spacecraft will be tracked. These profiles were

made with the SMT cone system tuned to 2295 MHz and the dichroic feed system extended.

Figure 3 shows similar X-band profiles for the same three elevation angles and the same azimuth angles. These profiles were made with the MXK system tuned to 8415 MHz and the dichroic feed system extended.

Table 2 lists the horizon mask data in tabular form for reference.

Figure 4 shows a summary of zenith system noise temperature measurements for calendar year 1973 for the S-band systems at DSS 14. The crosses are the data for maser serial number 96S3 in the polarization diversity S-band (PDS) cone operating in the diplexed mode. The circles are the data for the maser in the Module 3 area operating in the diplexed mode through the SMT cone. All these measurements (most of which were made by station personnel at DSS 14) were made with the Y-factor technique of switching between an ambient termination and the horn, but without regard for weather conditions.

References

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2. Clauss, R. C., and Wiebe, E. R., "Low-Noise Receivers: Microwave Maser Development," in this issue.
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4. Batelaan, P. D., Goldstein, R. M., Stelzried, C. T., "A Noise Adding Radiometer for Use in the DSN," in *The Deep Space Network*, Space Programs Summary 37-65, Vol. II, pp. 66-69, Jet Propulsion Laboratory, Pasadena, Calif., Sept. 1970.

Table 1. Summary of system operating noise temperature performance of SMT and MXK cones

Elevation angle, deg	Dichroic feed system extended		Dichroic feed system retracted	
	SMT cone 2295 MHz, K	MXK cone 8415 MHz, K	SMT cone 2295 MHz, K	MXK cone 8415 MHz, K
88	12.4	21.1	12.4	19.5
60	12.9	21.8	12.9	21.2
30	16.3	25.7	16.3	25.1

Table 2. Horizon masks at S- and X-band for three elevation angles

Azimuth angle, deg	Elevation angle 6 deg		Elevation angle 10 deg		Elevation angle 15 deg	
	SMT, K	MXK, K	SMT, K	MXK, K	SMT, K	MXK, K
105	30.9	47.0	24.7	38.7	20.9	33.6
115	31.0	46.8	24.7	38.5	21.2	33.6
125	31.4	47.4	25.0	39.0	21.0	33.9
135	32.1	48.8	25.4	39.6	21.2	33.9
145	33.1	50.1	26.0	39.9	21.5	34.7
155	34.4	51.6	26.2	40.8	21.6	35.2
165	33.7	51.0	26.2	40.9	21.6	35.2
175	33.3	50.9	26.1	40.7	21.6	34.9
180	33.1	50.5	26.1	40.7	21.6	35.1
185	32.8	50.0	25.8	40.5	21.4	34.9
195	32.4	49.2	25.6	39.9	21.4	34.9
205	32.2	48.4	25.5	39.5	21.3	34.8
215	32.1	48.2	25.4	39.5	21.3	34.7
225	32.1	48.8	25.6	39.7	21.3	34.7
235	32.4	49.6	25.6	40.2	21.4	34.7
245	32.3	49.0	25.6	39.9	21.3	34.6
255	32.3	49.0	25.6	39.8	21.3	34.6

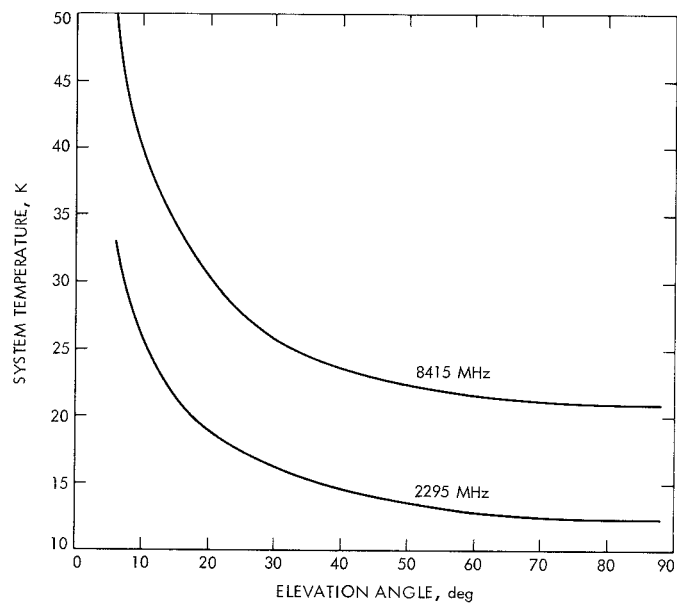


Fig. 1. S-band and X-band elevation profiles

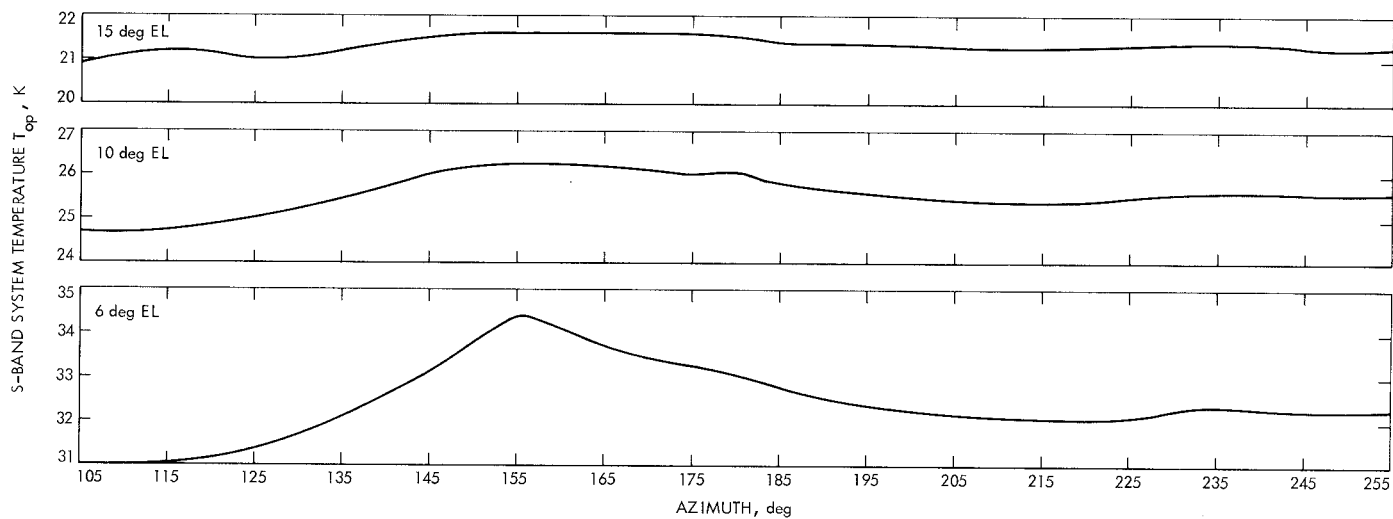


Fig. 2. S-band azimuth profiles

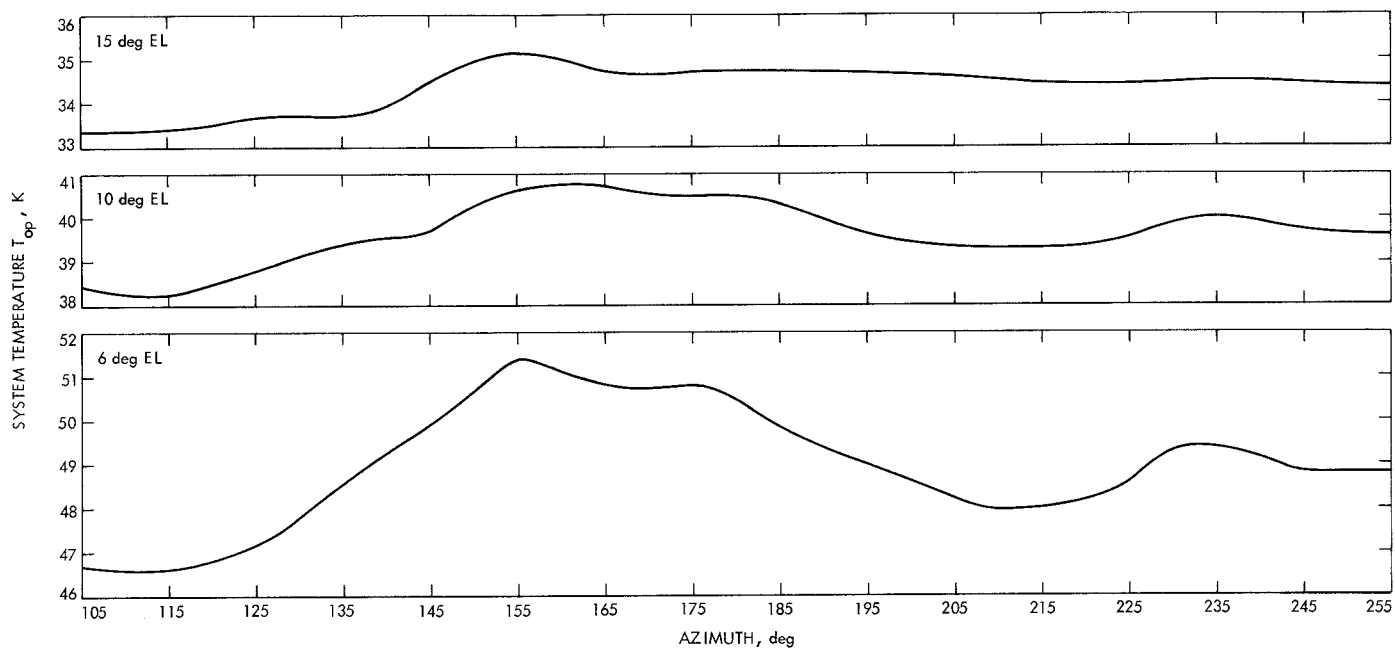


Fig. 3. X-band azimuth profiles

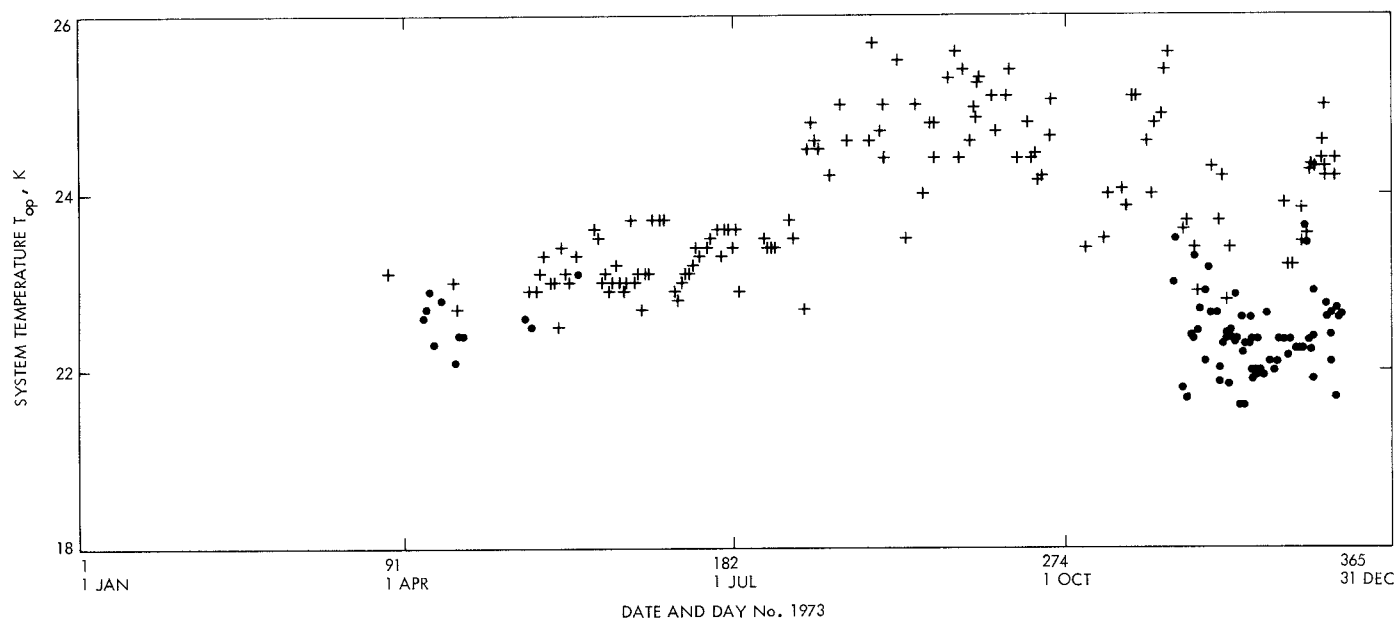


Fig. 4. Summary of DSS 14 duplexed S-band system temperatures for calendar year 1973